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JAPANESE PATENT OFFICE

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PATENT ABSTRACTS OF JAPAN

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(71) Applicant: TOYOTA MOTOR CORP

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(72) Inventor: NIWA SATORU

(54) BRAKING DEVICE

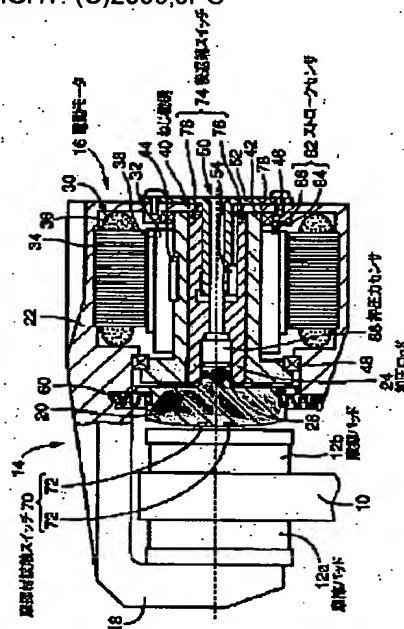
detected pressing power.

(57) Abstract

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PROBLEM TO BE SOLVED: To improve braking accuracy in an electric brake device wherein a pressing member is advanced by driving of an electric motor to press a friction member on a rotor, thereby actuating a brake.

SOLUTION: A detected pressing power of a pressing power sensor 88 in a non-actuating state of a brake and in a case where a pressurizing rod 24 is moved backward by an set amount and more, or moved backward to a back limit from that state, is set as a reference value. In this state, a practice pressing power is certainly in a 0 state, so that the detected pressing power is equal to an offset amount of 0 point. The offset amount is used as a reference value, and by controlling an electric motor 16 on the basis of the reference value and the detected pressing power, controlling accuracy of braking power can be improved better than by controlling the electric motor on the basis of the



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- ## DRAWINGS

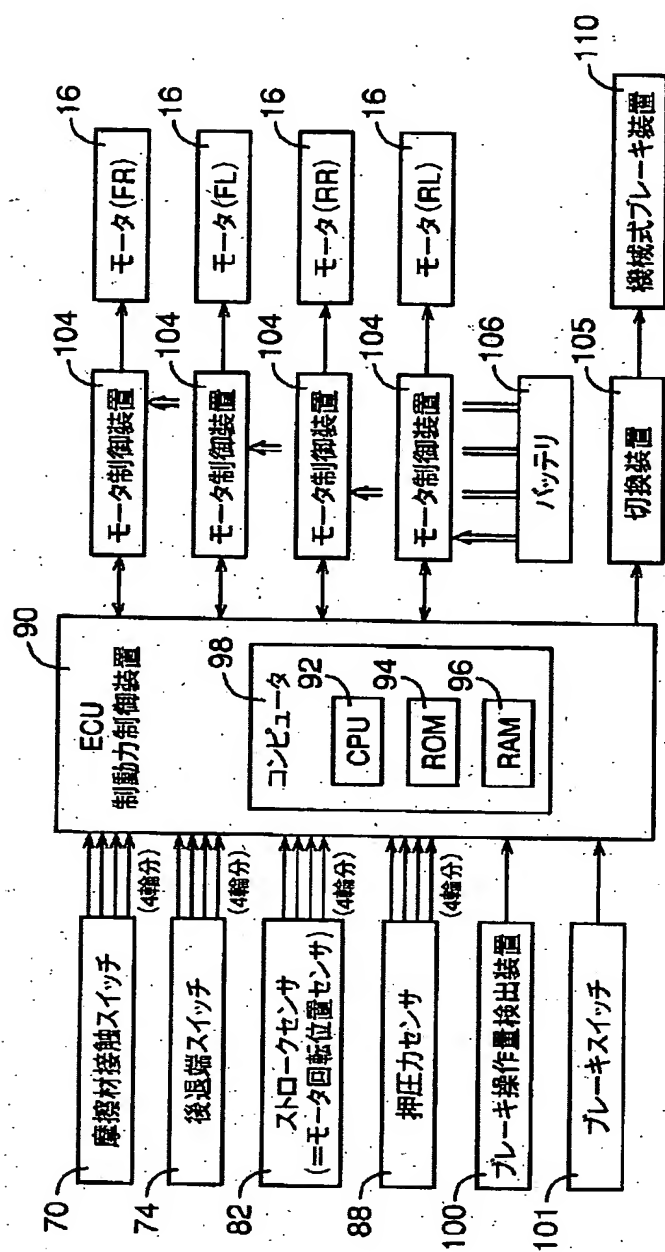
[illegible]

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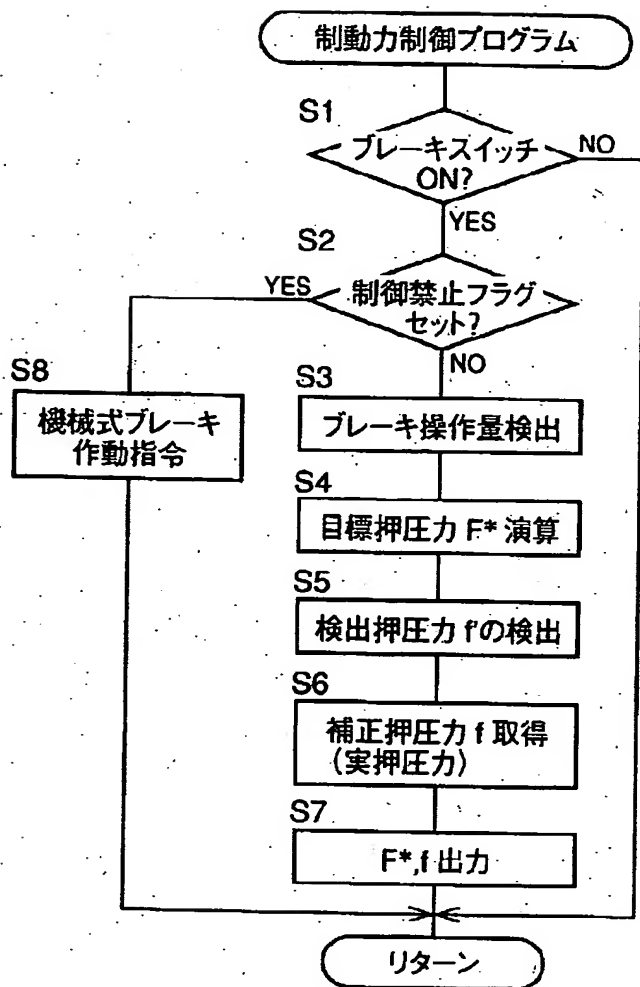
graph TD
    Start([モータ制御プログラム]) --> S21[S21]
    S21 --> S21_Box[目標押圧力 F*]
    S21_Box --> S22[S22]
    S22 --> S22_Box[実押圧力 f]
    S22_Box --> S23[S23]
    S23 --> S23_Box[F*, f 応じて電流制御]
    S23_Box --> Return([リターン])

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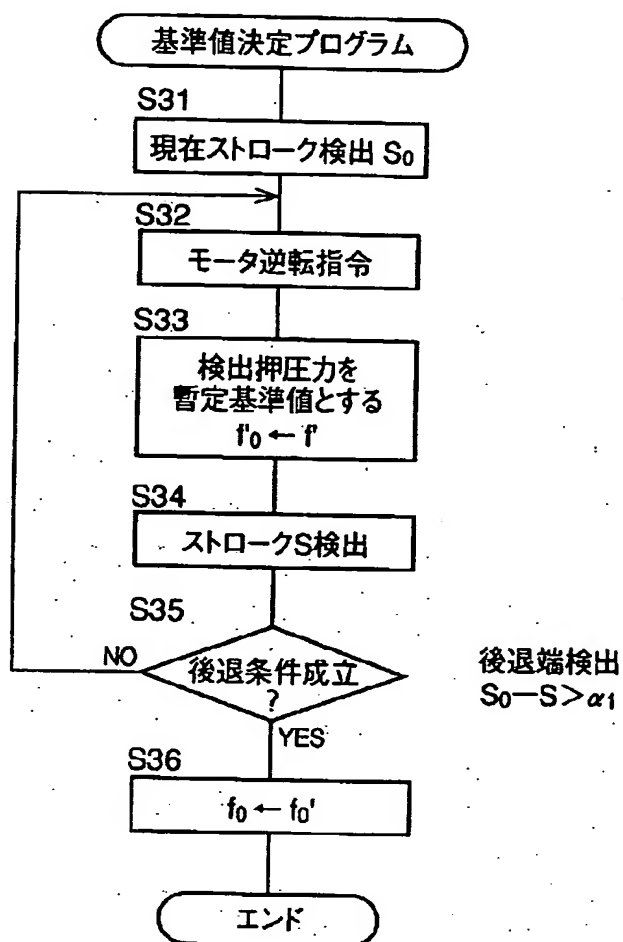
[ Drawing 2 ]



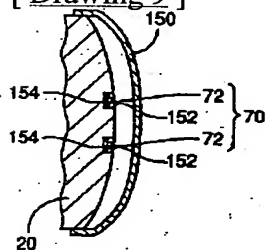
[ Drawing 3 ]



[ Drawing 5 ]

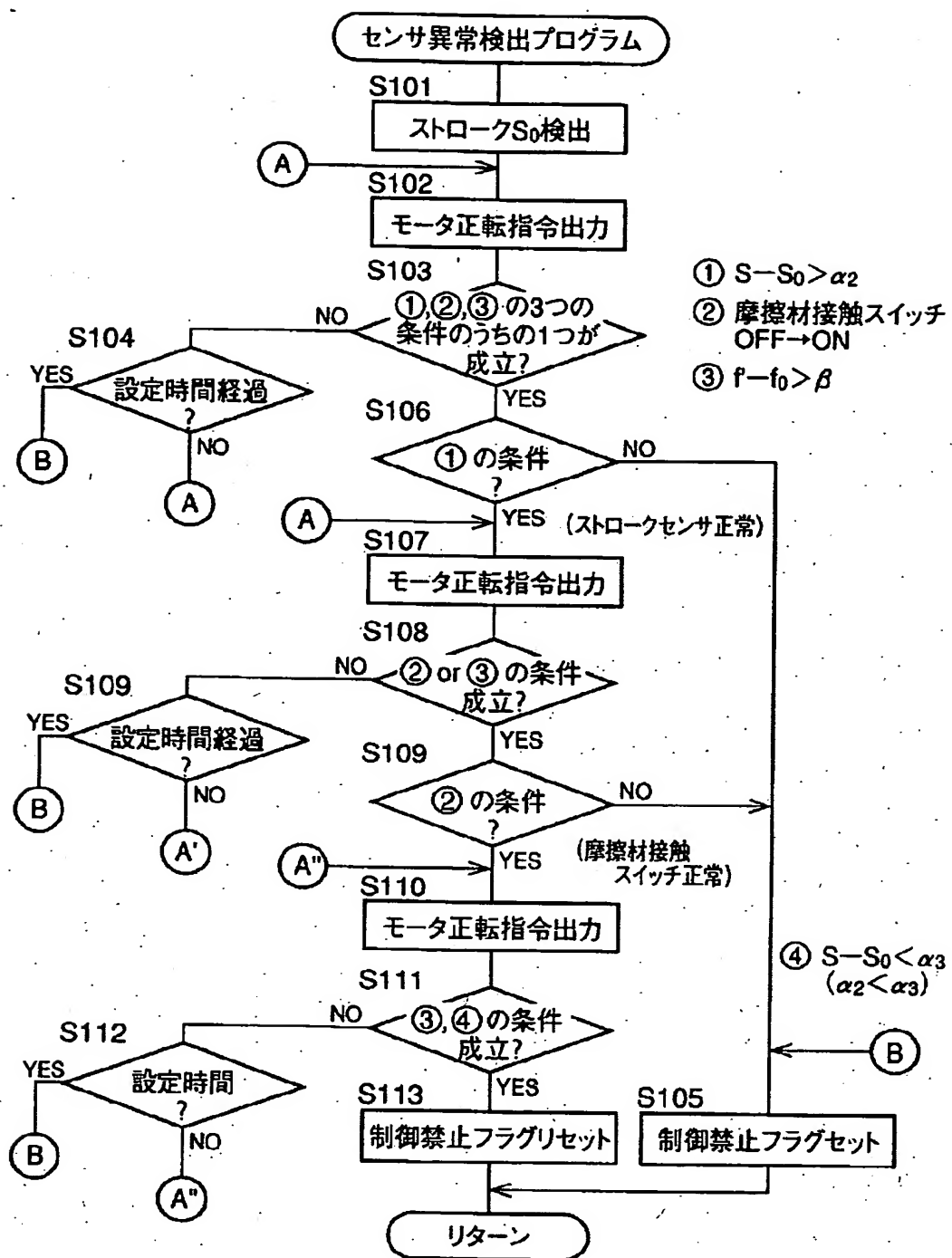


[ Drawing 9 ]

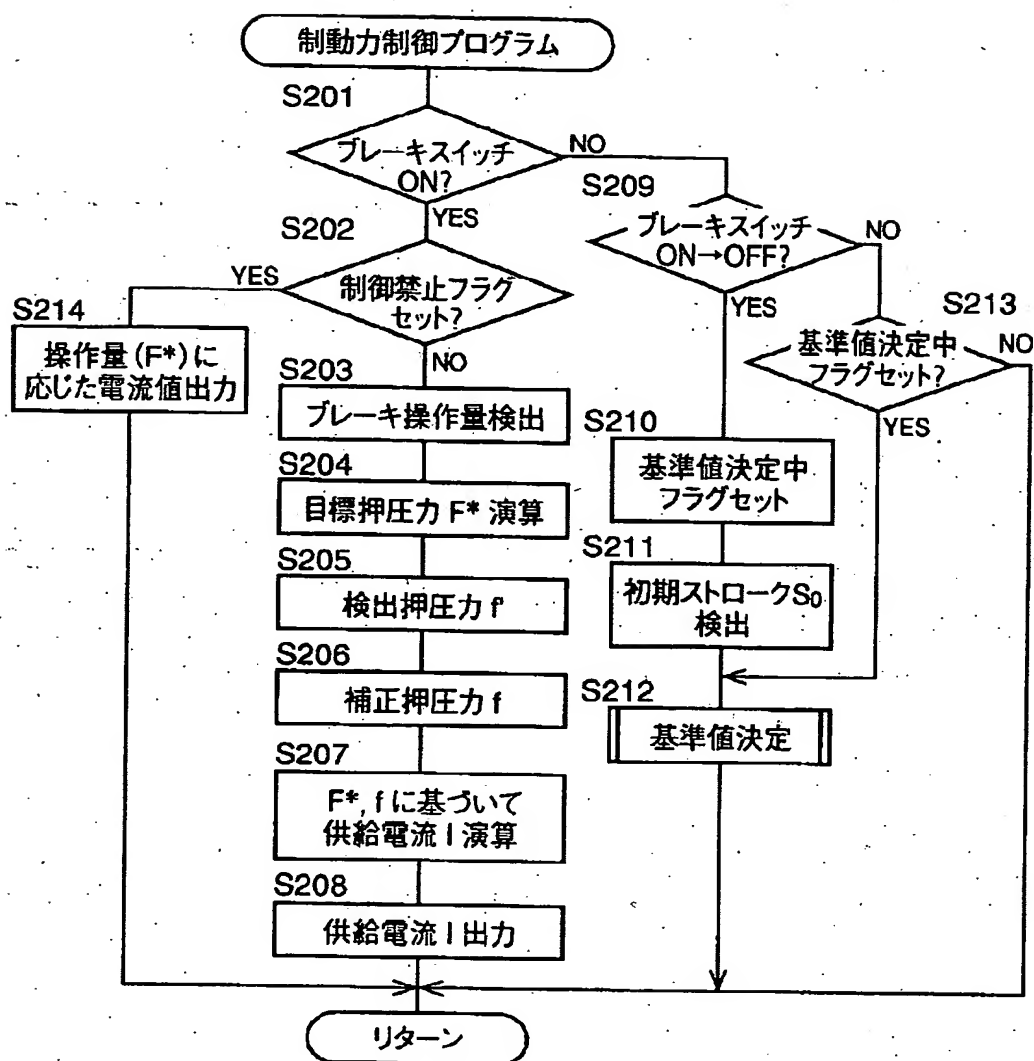


[ Drawing 6 ]

## センサ異常検出プログラム

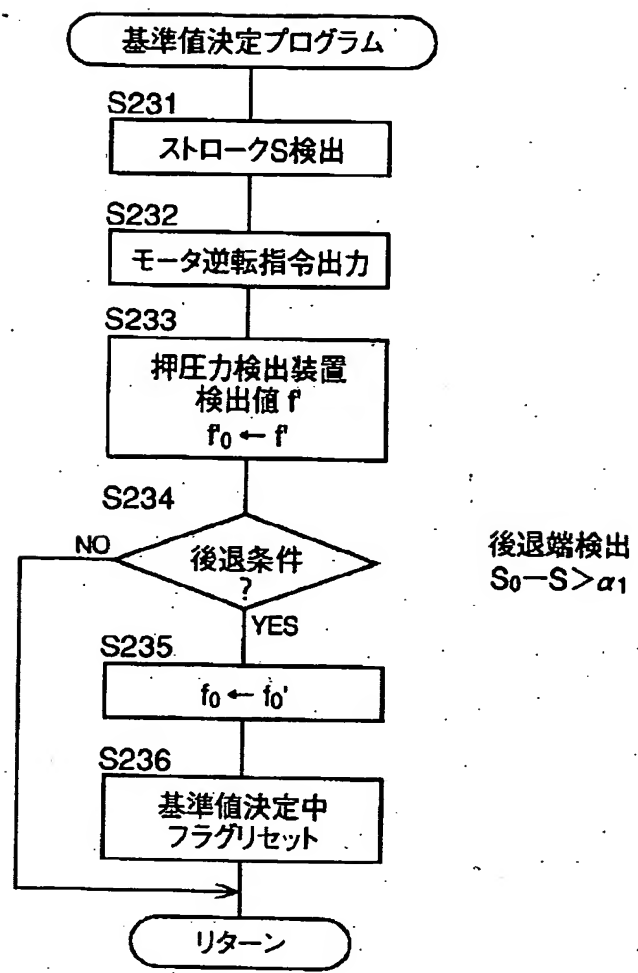


[ Drawing 7 ]



[ Drawing 8 ]





[Translation done.]

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DETAILED DESCRIPTION

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[Detailed description]

[0001]

[The technical field to which invention belongs] About a damping device, especially, this invention is pushed against body of revolution by friction material by the \*\*\*\* component, and relates to a control of the friction brake which suppresses rotation of body of revolution.

[0002]

[Prior art] As a kind of a damping device, there is what is indicated by the Provisional-Publication-No. 63\*\*242764 official report. The damping device of a publication contains the brake, the brake-force sensor, and the brake-force control unit in this official report. A brake suppresses rotation of a wheel, when a \*\*\*\* component is advanced by drive of an electrical motor and it is pushed against body of revolution by friction material including the body of revolution rotated with a wheel, the friction material prepared possible [ a contact and an alienation ] to the body of revolution, the \*\*\*\* component which pushes the friction material against the aforementioned body of revolution, and the electrical motor which moves forward and retreats the \*\*\*\* component. The brake force of the brake is detected by the brake-force sensor, and the operating state of an electrical motor is controlled by the brake-force control unit so that the detected detection brake force approaches the target brake force according to the treading strength of the brake pedal by the operator. In this damping device, although an actual brake force is detected by the brake-force sensor, although an actual brake force is 0, the detection brake force of a brake-force sensor is not set to 0 in many cases. That is, zero point of a brake-force sensor has offset in many cases. Of course, if the work which removes offset of zero point is performed particularly, although dissolution \*\*\*\*\* can perform such un-arranging, it cannot avoid that the cost of a damping device becomes high. Moreover, since it originates in change, an aging, etc. accompanied by a temperature change of the resistance of a strain gage and zero point shifts when \*\*\*\*\* detection equipment is what detects a load by the load cell equipped with the strain gage, one zero point offset elimination work is insufficient. The situation similar to this exists in other \*\*\*\*\* detection equipments. therefore, a certain amount of zero point offset -- not admitting -- it does not obtain, but when the operating state of an electric motor is made to be controlled so that a detection brake force approaches a target brake force as in an above-mentioned damping device, the problem of the grade which cannot control a brake force in the size according to the intention of an operator correctly arises

[0003]

[Object of the Invention, a technical-problem resolution means, and an effect] It makes as a technical problem that this invention makes the above situation a background and suppresses a fall of the braking force-control-precision resulting from zero point offset of the \*\*\*\*\* detection equipment which detects the pressing force which pushes friction material against body of revolution. And according to this invention, the damping device of following each mode is obtained. Like a claim, each mode is \*\*\*\*\*ed in a term, gives a number to each item, and indicates it in the format of quoting the number of other terms if needed. This is for making understanding of this invention easy to the last, and the technical characteristic features and those combination given in this specification should not be interpreted as being limited by each following item.

(1) The friction material prepared possible [ a contact and an alienation ] with the wheel to the body of revolution to come and its body of revolution. The brake which is pushed against body of

revolution by friction material by advance of a \*\*\*\* component, and suppresses rotation of a wheel including the \*\*\*\* component which pushes the friction material against the aforementioned body of revolution, In the \*\*\*\*\* detection equipment which detects \*\*\*\*\* of the aforementioned \*\*\*\* component, and a non-brake operating state The damping device characterized by including the reference-value decision equipment which makes detection \*\*\*\*\* of the aforementioned \*\*\*\*\* detection equipment in the status that it was made to retreat until the conditions by which the aforementioned \*\*\*\* component was able to be provided beforehand were fulfilled the reference value of the \*\*\*\*\* detection equipment (claim 1). Let the amount of offset of zero point of \*\*\*\*\* detection equipment be a reference value in a damping device given in this paragraph. When a brake is in a non-operating state, actual \*\*\*\*\* (real \*\*\*\*\* is called hereafter) is about 0. The status that the \*\*\*\* component was further retreated from the status is in the status that real \*\*\*\*\* is 0 certainly. Detection \*\*\*\*\* of the \*\*\*\*\* detection equipment in this status is the amount of offset of zero point, and let this value be a reference value. Although a \*\*\*\* component is retreated until the conditions defined beforehand are fulfilled, this condition is conditions for considering as the status that it can be considered that real \*\*\*\*\* is 0 certainly, and can also be called real \*\*\*\*\* 0 guarantee conditions. About this real \*\*\*\*\* 0 guarantee conditions, it is (2). Term - (4) A term is explained. It is (6) if a reference value is determined. A term or (8) An effect which is indicated in a term is acquired. For example, if a reference value rectifies detection \*\*\*\*\* of \*\*\*\*\* detection equipment, the detection precision of real \*\*\*\*\* can be raised. Moreover, if a braking force control is performed based on detection \*\*\*\*\* and a reference value, control precision can be raised as compared with the case where it controls based on the detection \*\*\*\*\* itself. Furthermore, it is also detectable whether abnormalities arose or not to the stroke detection equipment which detects the movement magnitude of a \*\*\*\* component using a reference value. It can also be thought that \*\*\*\*\* detection equipment is reaction force detection equipment which detects the reaction force to the \*\*\*\* component of friction material although it is the equipment which detects \*\*\*\*\* to the friction material of a \*\*\*\* component. Electric or magnetic change can be detected and \*\*\*\*\* detection equipment can adopt [ which is produced according to change of the force ] a load cell, a piezo-electric sensor, a semiconductor load sensor, a \*\*\*\*\* type force sensor, etc. as the component which receives the force corresponding to \*\*\*\*\* (reaction force).

(2) the case where it is detected including the retrocession edge detection equipment whose concerned damping device detects the retrocession edge of the aforementioned \*\*\*\* component that the aforementioned reference-value decision equipment was retreated to the retrocession edge to the aforementioned \*\*\*\* component by the aforementioned retrocession edge detection equipment -- the account of a front -- (1) which makes a reference value detection \*\*\*\*\* of the aforementioned \*\*\*\*\* detection equipment noting that the conditions defined beforehand are fulfilled The damping device (a claim 2) of the publication by the term. In the status that the \*\*\*\* component was retreated to the retrocession edge, real \*\*\*\*\* is 0 certainly. Therefore, a reference value, then a reference value can be certainly set as the true amount of zero point offset for the value of detection \*\*\*\*\* of the \*\*\*\*\* detection equipment in this status.

(3) the case reach to the amount of setup as which the amount of retrocession from the aforementioned non-brake operating state by which the aforementioned reference-value decision equipment was detected by the aforementioned movement-magnitude detection equipment was determined beforehand including the movement-magnitude detection equipment whose concerned damping device detects the movement magnitude of the aforementioned \*\*\*\* component -- the account of a front -- the (1) term which makes detection \*\*\*\*\* of \*\*\*\*\* detection equipment a reference value noting that the conditions defined beforehand are fulfilled, or (2) The damping device (a claim 3) of the publication by If only the amount of setup is retreated from the present position where a brake has a \*\*\*\* component in a non-operating state, in the position, real \*\*\*\*\* must surely be 0 and can set a reference value, then a reference value as the true amount of zero point offset for detection \*\*\*\*\* in this status certainly. Movement magnitude detection equipment can be considered as the equipment which is the equipment which detects the amount of relative displacement to the mainframe of a \*\*\*\* component drive actuator of a \*\*\*\* component, for example, detects the movement magnitude from the present position of a \*\*\*\* component, or can be considered as the equipment which detects the relative position to the mainframe of an actuator of a

\*\*\*\* component, and detects movement magnitude based on change of the relative position.

Movement magnitude and a relative position may be made to be detected indirectly based on the amount of operations of an actuator, even if a direct detection is made to be carried out. Anyway, "a move" and a "position" shall have a close relation and position detection equipment shall also be included in movement magnitude detection equipment.

(4) the case which carried out setup-time progress where the aforementioned reference-value decision equipment is beforehand defined after detection \*\*\*\*\* of the aforementioned pressing force detection equipment stopped decreasing during retrocession of the aforementioned \*\*\*\* component -- the account of a front -- (1) which makes a reference value detection \*\*\*\*\* of the aforementioned \*\*\*\*\* detection equipment noting that the conditions defined beforehand are fulfilled A term or (3) Damping device [ term ] (claim 4) of any one publication. Although detection \*\*\*\*\* decreases as it retreats while the contact status is maintained, when a \*\*\*\* component is retreated from the status that it is in contact with friction material, if it estranges, detection \*\*\*\*\* will not decrease any more. Therefore, if the status that it stopped decreasing passes more than the setup time, it can be considered that a \*\*\*\* component is certainly estranged from friction material, and is in the status that real \*\*\*\*\* is 0 certainly.

(5) (1) in which the aforementioned brake contains advance and the electrical motor to retreat for the aforementioned \*\*\*\* component to the aforementioned friction material A term or (4) Damping device of any one publication of the term (claim 5). A drive of an electrical motor does the advance and the retrocession of a \*\*\*\* component to friction material. A rotary motor or a linear motor is sufficient as an electrical motor, when it is a rotary motor, rotation is changed into rectilinear motion by the ball thread etc., and it is transmitted to a \*\*\*\* component. An electric brake has a typical brake given in this paragraph.

(6) (1) in which the concerned damping device contains an amendment \*\*\*\*\* compensator for detection \*\*\*\*\* of the aforementioned \*\*\*\*\* detection equipment based on the reference value determined by the aforementioned reference-value decision equipment A term or (5) Damping device of any one publication of the term. Detection \*\*\*\*\* is rectified based on a reference value. Although rectified detection \*\*\*\*\* is called amendment \*\*\*\*\* , since amendment \*\*\*\*\* serves as the value near real \*\*\*\*\* from detection \*\*\*\*\* , it can raise the detection precision of \*\*\*\*\* by amendment. If the amendment which lengthens a reference value from detection \*\*\*\*\* is performed when \*\*\*\*\* detection equipment is what has a linear characteristic (i.e., when it is what detection \*\*\*\*\* increases linearly in connection with the increase in real \*\*\*\*\* ), real \*\*\*\*\* can be acquired and \*\*\*\* can be rectified.

(7) (1) containing the actuator control unit with which the concerned damping device controls the actuator which moves forward and retreats the aforementioned \*\*\*\* component, and its actuator based on the reference value determined by the aforementioned reference-value decision equipment, and detection \*\*\*\*\* of the aforementioned \*\*\*\*\* detection equipment A term or (6) Damping device of any one publication of the term. An actuator is controlled based on a reference value and detection \*\*\*\*\* . The control precision of a brake force can be raised as compared with the case where it is controlled only based on detection \*\*\*\*\* . (6) The mode which controls an actuator in a term based on amendment \*\*\*\*\* of a publication is an example of this mode. It is an actuator (5) The electrical motor of a publication shall be included in a term.

(8) The amount detection equipment of move relations whose concerned damping device detects the amount of move relations relevant to a move of the aforementioned \*\*\*\* component, With the aforementioned reference-value decision equipment (1) containing the malfunction detection equipment which detects that abnormalities arose based on the reference value and the detection value of the amount detection equipment of move relations which were determined at least in one side of the amount detection equipment of move relations, and the aforementioned \*\*\*\*\* detection equipment A term or (7) Damping device of any one publication of the term (claim 6). If a reference value is used, it is detectable that abnormalities arose at least in one side of the amount detection equipment of move relations and \*\*\*\*\* detection equipment. Not only the amount of relative displacement to the mainframe of an actuator of a \*\*\*\* component but the relative position which becomes the base of the amount acquisition of relative displacement is contained in the amount of move relations. The specific relative positions as which it was determined beforehand, such as a

relative position to which for example, a \*\*\*\* component contacts friction material, and a relative position located in a retrocession edge, are also contained in a relative position. It corresponds to it and is (3) in the amount detection equipment of move relations. Not only movement magnitude detection equipment given in a term but (2) The retrocession edge detection equipment of a publication, the friction material contact detection equipment which detects that the \*\*\*\* component contacted friction material are included in a term. Anyway, \*\*\*\*\* is controlled based on the amount of move relations of a \*\*\*\* component, and has a close relation between \*\*\*\*\* and the amount of move relations of a \*\*\*\* component. Therefore, if based on a reference value and the detection value of the amount detection equipment of move relations, it can judge whether a detection value or a reference value is an appropriate value, and can detect that abnormalities arose to the amount detection equipment of move relations, or \*\*\*\*\* detection equipment. For example, although it is detected by retrocession edge detection equipment that the \*\*\*\* component is located in a retrocession edge, when detection \*\*\*\*\* of \*\*\*\*\* detection equipment is larger than a reference value, it can detect that abnormalities arose in either of retrocession edge detection equipment and \*\*\*\*\* detection equipment. Moreover, when it is the value to which the detection value of \*\*\*\*\* detection equipment and the amount detection equipment of move relations was mutually contradictory, it can detect that abnormalities arose in either of both the detections equipments. Furthermore, when the three or more amount detection equipments of move relations are formed, it can be determined by comparison of those detection results which amount detection equipment of move relations is unusual. In addition, if it assumes that \*\*\*\*\* detection equipment is normal, it is also possible to detect whether the amount detection equipment of move relations is unusual based on a reference value and the detection value of the amount detection equipment of move relations. In this case, it is also possible to detect in consideration of detection \*\*\*\*\* by \*\*\*\*\* detection equipment.

(9) (8) The damping device of the publication by the term. [ contain / an amount disable means of unusual move relations forbid use by the braking control at least of one side with \*\*\*\*\* detected by the amount of move relations detected by the amount detection equipment of move relations, and \*\*\*\*\* detection equipment when the concerned damping device had at least unusual one side of the aforementioned amount detection equipment of move relations, and \*\*\*\*\* detection equipment and it was detected by the aforementioned malfunction-detection equipment ] When at least one side of the amount detection equipment of move relations and \*\*\*\*\* detection equipment was unusual and it is detected, the use to one [ at least ] braking control of the amount of move relations and \*\*\*\*\* is forbidden. When whether it is unusual either among the amount detection equipment of move relations and \*\*\*\*\* detection equipment can detect, the braking control based on the detection value detected by normal equipment is possible. Moreover, when there are two or more amount detection equipments of move relations and the unusual amount detection equipment of move relations can be specified, the braking control based on the amount of move relations detected by the normal amount detection equipment of move relations is possible. To it, when amount detection equipment [ of move relations ] and \*\*\*\*\* detection equipment is also unusual, use of these detection values is forbidden. Moreover, even if there is only the one amount detection equipment of move relations or there were more than one, when unusual [ altogether ] and it is detected, it is the same, and all braking controls based on the amount of move relations are forbidden. In this case, although the run of a vehicle itself is forbidden in many cases, if the brake switch is normal, for example The braking control is able to be made to be performed so that the damping force of the pattern defined beforehand may be obtained according to change of the output signal of a brake switch. Moreover, when the pure mechanical brake to which the concerned damping device operates mechanically purely independently with the aforementioned brake is included, it is also possible for it to be made to be switched to the status that the pure mechanical brake operates.

[0004]

[Gestalt of implementation of invention] Hereafter, the damping device as 1 enforcement gestalt common to invention concerning the claim 1 or 6 is explained in detail based on a drawing. In this enforcement gestalt, a damping device is applied to the electric brake gear for vehicles. The electric brake gear for vehicles includes the braking force-control equipment which controls the damping force by the disk brake prepared in the right and left rings of each and the disk brake.

brake is shown in drawing 1 and the braking force-control equipment which makes a computer a subject at drawing 2 is shown.

[0005] A disk brake is an electric brake which makes an electrical motor a driving source, and contains the disk 10 as body of revolution which rotates with a wheel, friction-pad 12a of a couple and b, the caliper 14 which holds friction-pad 12a and b ranging over a disk 10, and the electrical motor 16 which operates a brake by pushing friction-pad 12a and b against a disk 10. A caliper 14 is attached in the orientation of an axis of that possible [ a slide ] to a disk 10 at the holddown member which fixation into the car body does not illustrate. The reaction section 18 which \*\*\*\*s from the back to one friction-pad 12a, and \*\*\*\*\* 22 which supports the friction material contact component 20 which \*\*\*\*s from the back to friction-pad 12b of another side, and the pressurization rod 24 possible [ a move in the orientation of an axis ] are formed at this caliper 14. The aforementioned electrical motor 16 is attached in \*\*\*\*\* 22. the friction material contact component 20 is supported possible [ a slide ] to the pressurization rod 24 moved forward and retreated by drive of an electrical motor 16 -- having -- \*\*\*\* -- a move of the pressurization rod 24 -- friction-pad 12b -- receiving -- contact - it is made to estrange A sign 26 is a seal component. In this enforcement gestalt, although the pressurization rod 24 and the friction material contact component 20 are \*\*\*\* components said to a claim 1, the pressurization rod 24 can also consider a \*\*\*\* component. The pressing force of the \*\*\*\* rod 24 is transmitted to friction component 12b through the friction material contact component 20. In addition, the advance and the retrocession of the friction material contact component 20 and the pressurization rod 24 can also be enabled in one.

[0006] A stator 30 and Rota 32 are arranged possible [ relative rotation ] in same axle, and the electrical motor 16 is constituted. A coil 34 is twisted around a core 36 and the stator 30 is constituted. Rota 32 equips the position which counters a stator 30 with the permanent magnet 38 \*\*\*\*ed by turns by the hoop direction at N pole and the south pole. The pressurization rod 24 is made to carry out a straight-line move through the screw-thread device 40 by rotation of an electrical motor 16. The screw-thread device 40 as a movement inverter is a ball-thread device in this enforcement gestalt, it is acceptable as an output shaft and the screw-thread component 42 is \*\*\*\*ed through two or more balls which are not illustrated to the male screw component (pressurization rod) 24 as an output rod. Rotation of the female screw component 42 is enabled by the key 44 in one with Rota 32. The female screw component 42 is again supported by \*\*\*\*\* 22 possible [ relative rotation ] through bearings 46 and 48. The female screw component 42 is supported to \*\*\*\*\* 22 in that relative rotation is possible and the status which cannot be displaced relatively to shaft orientations. The male screw component 24 is formed in shaft orientations by the rotation prevention section 50 to it in that relative displacement is possible and the status which cannot be relative rotated. The rotation prevention section 50 calls a key coupling scheme, and is made impossible [ relative rotation ] by the key 54 to the rotation prevention mainframe 52 with which the male screw component 24 was fixed to \*\*\*\*\* 22.

[0007] Moreover, the seal component 60 is formed between the caliper 14 and the friction material contact component 20. The seal component 60 prevents an entry of the foreign matter to the interior etc., permitting the move of shaft orientations to the caliper 14 of the friction material contact component 20. The friction material contact switch 70 is formed in the point of the friction material contact component 20. The friction material contact switch 70 is a switch which detects whether the friction material contact component 20 touches the tooth back of the backing of friction-pad 12b in the point of that. The friction material contact switch 70 is equipped with the contact 72 of a couple, and if these contact the backing which has conductivity, the contact 72 of a couple will be in the electric conduction status. Therefore, if between the contacts 72 of a couple switches from the status (OFF) that current is not conducted to the electric conduction status (ON), it turns out that the friction material contact component 20 contacted friction-pad 12b at the time of advance of the pressurization rod 24. The same switch 74 is formed also in the retrocession end face of the pressurization rod 24. When the contact 76 of a couple contacts the motor attaching part 78 of \*\*\*\*\* 22, it is detectable whether the pressurization rod 24 is located in a retrocession edge. The fraction to which the motor attaching part 78 counters the aforementioned contact 76 shall have conductivity. This switch 74 can be considered to be a retrocession edge switch and an interlock switch. When a brake force is controlled based on a stroke, the friction material contact component



20 can think that it is the zero of a stroke of the position in contact with friction-pad 12b, and can consider the above-mentioned friction material contact switch 70 to be a zero stroke switch. However, when it is a problem whether friction-pad 12b is contacted and it detects the stroke to an electrical motor 16, there is not necessarily no need of making the position in contact with friction-pad 12b into zero point of a stroke. For example, a retrocession edge position can be made into the zero of a stroke, and the position in contact with friction-pad 12b can also be considered as the greatest position of a stroke. In this enforcement gestalt, the absolute value of a stroke makes the side near a retrocession edge a parvus side.

[0008] The stroke in the shaft orientations of the pressurization rod 24 is detected by the stroke sensor 82. The stroke sensor 82 contains the rotary encoder which detects the rotation position of Rota 32 in an electrical motor 16. The rotation position of the detecting element 84-ed is magnetically detected including the detecting element 84-ed prepared in the Rota 32 side to rotate, and the detecting element 86 prepared in the motor attaching part 78 side which is a holddown member. In addition, a rotary encoder shall detect a rotation position optically. \*\*\*\*\* of the friction material contact component 20 is detected by \*\*\*\*\* 88. \*\*\*\*\* 88 detects the force in which the pressurization rod 24 pushes the friction material contact component 20 against friction-pad 12b. \*\*\*\*\* 88 enables it to receive those axial tension between the friction material contact component 20 and the pressurization rod 24. The electric change resulting from change of the pressing force of the pressurization rod 24 is detected, and it considers as the load cell in this enforcement gestalt. \*\*\*\*\* 88 is also a reaction force sensor which detects the reaction force received from friction-pad 12b through the friction material contact component 20.

[0009] The braking force-control equipment 90 is what makes a subject the computer 98 containing CPU92, ROM94, RAM96, etc., as shown in drawing 2. among the input section of that While the above-mentioned friction material contact switch 70, the retrocession edge switch 74, the stroke sensor 82, and \*\*\*\*\* 88 are connected The amount detection equipment 100 of brakes operations which detects the control input of the brake pedal not to illustrate, the brake switch 101 which detects whether the brake pedal is operated are connected. Moreover, the motor control equipment 104, the switching unit 105, etc. are connected to the output section. The motor control equipment 104 is target \*\*\*\*\*F\* supplied from the braking force-control equipment 90. Based on the information to express and the information showing real \*\*\*\*\* f, the supply current to an electrical motor 16 is controlled, and it controls so that the current according to the supply current flows from a battery 106 to an electrical motor 16. A switching unit 105 is switched to the operation permissive condition which permits the operation prohibition status forbid an operation of the mechanical brake gear 110, and an operation.

[0010] The braking force-control program expressed with the flow chart of drawing 3, the reference-value decision program expressed with the flow chart of drawing 5, the sensor malfunction detection program expressed with the flow chart of drawing 6 are stored in ROM94. Moreover, the motor control program expressed with the flow chart of drawing 4 is stored in ROM of the motor control equipment 104.

[0011] The operation in the damping device constituted as mentioned above is explained. In this enforcement gestalt, as mentioned above, the supply current to an electrical motor 16 is controlled based on target \*\*\*\*\* and real \*\*\*\*\* , and it is controlled so that the brake force according to an operator's brakes-operation force is obtained. It considers as amendment \*\*\*\*\* by which the value based on detection \*\*\*\*\* and the reference value of \*\*\*\*\* 88 in real \*\*\*\*\* , i.e., detection \*\*\*\*\* , was rectified here based on the reference value. Detection \*\*\*\*\* may not be 0 even if real \*\*\*\*\* is 0 by the offset of zero point of \*\*\*\*\* 88. Therefore, if the amount of offset is made into a reference value and detection \*\*\*\*\* is rectified based on a reference value, the detection precision of real \*\*\*\*\* can be raised. Moreover, based on the reference value, the abnormalities of the friction material contact switch 70, the stroke sensor 82, and \*\*\*\*\* 88 are detected. Acquisition of the above-mentioned reference value and a detection of abnormalities are performed at the time of an initial check after setting an ignition switch to ON. Although the control-prohibition flag was maintained at the reset status when all of the above-mentioned friction material contact switches 70, the stroke sensors 82, and \*\*\*\*\*s 88 were normal and it was detected as a result of malfunction detection, when at least one was unusual and it is detected, it is

switched to the set status. If a control prohibition flag is set, a control of an electrical motor 16 will be forbidden and the mechanical brake gear 110 will be switched to an operation permissive condition by control of a switching unit 105.

[0012] In the braking force-control equipment 90, the braking force-control program expressed with the flow chart of drawing 3 is performed. Step 1 (it is hereafter called S1 for short.) It sets to suppose that it is the same about other steps, it is detected whether it is under [ brakes-operation ] \*\*\*\*\* , and it is detected in S2 whether a control prohibition flag is in the set status or it is in the reset status. It is among a brakes operation, and when normal, YES and a judgment of in S2 in a judgment of in S1 in all above-mentioned sensors serve as NO, and a control of the brake force by control of an electrical motor 16 is performed after S3.

[0013] In S3, the amount of brakes operations by the operator is detected based on the output value of the amount detection equipment 100 of brakes operations, and it responds to the control input in S4, and is target damping force, i.e., target \*\*\*\*\*F, \*. It is asked according to an operation. Reference value f0 which detection \*\*\*\*\* f was detected based on the output signal of \*\*\*\*\* 88, and was calculated in S6 in S5 at the time of an initial check It is based and detection \*\*\*\*\* f is rectified. And it sets to S7 and is target \*\*\*\*\*F\*. Real \*\*\*\*\* f is outputted to the motor control equipment 104. Detection \*\*\*\*\* f is a reference value f0. The value rectified by being based, i.e., amendment \*\*\*\*\* , is set to real \*\*\*\*\* f. When the control prohibition flag is set, the judgment in S2 serves as NO, and feedback control is forbidden. In this enforcement gestalt, in S8, the mechanical brake gear 110 is switched to an operation authorized state by control of a switching unit 105 from the operation prohibition status, and the mechanical brake gear 110 is operated. Moreover, when the brake is not operated, the judgment in S1 serves as NO. In this case, a control of an electrical motor 16 is not performed.

[0014] In the motor control equipment 104, it sets to S 21 and 22 to it, and is target \*\*\*\*\*F\*. It reaches, real \*\*\*\*\* f is read, and it sets to S23, and is real \*\*\*\*\* f Target \*\*\*\*\*F\* The control brought close is performed. Real \*\*\*\*\* f is target \*\*\*\*\*F\*. A current is supplied to an electrical motor 16 so that it may approach. In this case, since not detection \*\*\*\*\* but amendment \*\*\*\*\* (real \*\*\*\*\* ) is fed back, control precision can be raised.

[0015] Next, the operation in the braking force-control equipment 90 at the time of an initial check is explained. A reference value is determined according to the reference-value decision program execution expressed with the flow chart of drawing 5 . Let output \*\*\*\*\* of \*\*\*\*\* 88 in the status that real \*\*\*\*\* is 0 certainly be a reference value in this enforcement gestalt. For the status are 0 certainly, the pressurization rod 24 when a brake is a non-operating state and the pressurization rod 24 is retreated from the brake non-operating state to a retrocession edge position is the amount alpha 1 of setup. It considers as the case (S0-S> alpha 1) where it is retreated above. When at least one side is filled between these two conditions, it is supposed that retrocession conditions were fulfilled (real \*\*\*\*\* 0 guarantee conditions was filled), and let detection \*\*\*\*\* in that case be a reference value.

[0016] A stroke at present is detected in S31, and it is the initial stroke S0. It is carried out. And in S32, a command of the purport which an opposite direction is made to rotate with the setting rotational speed which was able to define the electrical motor 16 beforehand is outputted to the electrical-motor control unit 104. The electrical-motor control unit 104 controls a supply current so that [ an electrical motor 16 ] it is rotated by the opposite direction with setting rotational speed. Consequently, in a disk brake 8, it is retreated at the setting speed as which the pressurization rod 24 was determined beforehand. Detection \*\*\*\*\* f of \*\*\*\*\* 88 is made into temporary-standard value f0 ' in S33. In S34, the present stroke S is detected and it is judged in S35 whether above-mentioned retrocession conditions are fulfilled. When S35 is performed first, since a judgment serves as NO, it is returned to execution of S32 and the same execution as a grade to which a command of the purport which makes an opposite direction rotate an electrical motor 16 at a setting speed is outputted is performed repeatedly. When retrocession conditions are fulfilled, the judgment in S35 serves as YES, and it sets to S36, and temporary-standard value f0 ' in that case is a reference value f0. It is carried out. Since real \*\*\*\*\* is 0 certainly when retrocession conditions are fulfilled, detection \*\*\*\*\* in the status is the amount of offset, and let it be a reference value.

[0017] Next, it is detected according to the sensor malfunction detection program execution to which





In this enforcement gestalt, the stroke sensor 82 and the friction material contact switch 70 correspond to movement magnitude detection equipment. In addition, in the above-mentioned enforcement gestalt, although the supply-current value to an electrical motor 16 is made to determine in the motor control equipment 104, it can determine in the braking force-control equipment 90. Moreover, after detection \*\*\*\*\* of the \*\*\*\* sensor 90 stops falling, also let detection \*\*\*\*\* at the time of passing more than the setup time be a reference value. Furthermore, if based on a reference value, it is also detectable that abnormalities arose on the retrocession edge switch 74. For example, it is detectable if at least one side of the retrocession edge switch 74 and \*\*\*\*\* 88 is unusual when the retrocession edge switch 74 is in ON status although amendment \*\*\*\*\* f is a value larger than 0. Moreover, in the above-mentioned enforcement gestalt, although both the decision of a reference value and the malfunction detection of a sensor are made to be performed at the time of an initial check, decision of a reference value can be performed at the time of operation cancel of a brake. At the time of the decision of a reference value, since the \*\*\*\*\* rod 24 is retreated, it is appropriate to carry out, when operation of a brake pedal is canceled. The operation in the braking force-control equipment 90 in that case is expressed with drawing 7 and the flow chart of 8.

[0022] In this case, in S203-S208, it sets to the braking force-control equipment 90, and is target \*\*\*\*\*F\*. Based on amendment \*\*\*\*\* f, supply-current value I is calculated according to an operation, and is outputted to the motor control equipment 104 (a motor driver is sufficient). The current according to the supply-current value I is supplied to an electrical motor 16 from a battery 106. And in S232, supply-current value I for making it rotate at the setting speed to which the electrical motor 16 was beforehand set by the opposite direction is outputted [ be / under / reference-value decision / setting / it ]. An electrical motor 16 is rotated by the opposite direction at a setting speed, and is retreated at a fixed speed to the pressurization rod 24. Hereafter, a reference value is determined like the case in the above-mentioned enforcement gestalt.

[0023] When a brakes operation was canceled, decision of a reference value was performed once, it comes out enough and the brake switch 101 switches from ON status to OFF status for a certain reason, it carries out for carrying out only once. therefore, when it is during a brake non-operating state continuation and a flag is in the reset status during reference-value decision, decision of a reference value is not performed (when a judgment of S209 and S213 is NO) -- it is made like (execution of S212 is not performed) During reference-value decision, a flag is reset, when the decision of a reference value is completed. If a brake pedal is trodden in during reference-value decision, a judgment of S201 will serve as YES and S202 or subsequent ones will be performed. When treading in to a brake pedal is canceled again, the judgment in S209 serves as YES, and S210 or subsequent ones are performed. Here, although a reference-value decision flag will be set again, it does not interfere. When it is [ reference-value ] under decision and the reference value is not decided, the brake pedal was trodden in and the reference value with which the brake control in this case was decided last time is used. If a reference value is decided this time, the temporary-standard value f0 ' is a reference value f0. It is carried out.

[0024] Moreover, when a control prohibition flag is in the set status, in S214, supply-current value I to an electrical motor 16 is determined based on the output control input of the amount detection equipment 100 of brakes operations. In this case, it is because it is not appropriate to control based on detection values, such as \*\*\*\*\* 88 and the stroke sensor 82. In addition, programmed-current value I0 beforehand defined in S214 It enables it to be outputted or can enable it to operate the mechanical brake prepared apart from the electric brake. Programmed-current value I0 When outputted, a fixed brake force will be obtained irrespective of the size of a control input.

[0025] Moreover, although the control prohibition flag is made to be set when it is detected in each above-mentioned enforcement gestalt that abnormalities arose in at least one of \*\*\*\*\* 88, the stroke sensor 82, and the friction material contact switches 70 When the abnormalities of \*\*\*\*\* 88 are detected When the \*\*\*\*\* unusual flag showing that is set and the abnormalities of the stroke sensor 82 are detected The stroke sensor unusual flag showing that is set, and a control of an electrical motor 16 can be performed using the detection value of a normal sensor. Furthermore, \*\*\*\*\* 88 can assume the abnormalities of the stroke sensor 82 and the friction material contact switch 70 to be normal, and can also detect them. That is, based on real

\*\*\*\*\* determined based on detection \*\*\*\*\* and the reference value of \*\*\*\*\* 88, and the detection value of the stroke sensor 82 or the friction material contact switch 70, it judges whether the detection value of the stroke sensor 82 and the friction material contact switch 70 is an appropriate value, and detects whether it is unusual based on it.

[0026] Moreover, it can also consider as the configuration which shows the point of the friction material contact component 20 in which the friction material contact sensor 70 was attached to drawing 9. Since it is not desirable that the contact 72 of the friction material contact sensor 70 is exposed to the external ambient atmosphere, it \*\*\*\*\*s through the elastic component 154 to the concavity 152 of the couple which covers the point of the friction material contact component 20 with the diaphragm 150 formed with the conductive material, and was formed in the apical surface. If the friction material contact component 20 contacts friction-pad 12b and a diaphragm 150 is stir-fried, contacts will conduct current. A contact 72 can be protected with a diaphragm 150. Moreover, trauma of a contact 72 can be made small by the elastic component 154.

[0027] Furthermore, in the above-mentioned enforcement gestalt, although the control of an electrical motor 16 is made to be performed based on target \*\*\*\*\* and real \*\*\*\*\* , it can be carried out based on the detection value of the stroke sensor 82. Moreover, the friction material contact switch 70, the stroke sensor 82, the retrocession edge switch 74, etc. are not indispensable. Furthermore, the pressurization rod 24 and the friction material contact component 20 can also be formed possible [ advance and retrocession ] in one. In this case, the direct detection of the \*\*\*\*\* to friction-pad 12b of the friction material contact component 20 will be carried out. Moreover, in the above-mentioned enforcement gestalt, although the DC motor was prepared as an actuator, you may form the motor of other gestalt, such as not only a DC motor but an ultrasonic motor, an AC motor, etc. It can also consider as the actuator using the piezoelectric device. The gestalt of a DC motor is not necessarily limited to the above-mentioned enforcement gestalt, either. Furthermore, it is applicable not only to a disk brake but a drum brake. In addition, although not illustrated one by one, it can carry out with the gestalt which gave various change and enhancement based on the knowledge of these contractors including the mode indicated by the term of the above [Object of the Invention, a technical-problem resolution means, and an effect].

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[Translation done.]